ANNUAL REPORT 1965

MARKHAM VILLAGE

water pollution control plant

DIVISION OF PLANT OPERATIONS

Ontario Water Resources Commission

ONTARIO WATER RESOURCES COMMISSION

OFFICE OF THE GENERAL MANAGER

Members of the Markham Village Local Advisory Committee,
Village of Markham.

Gentlemen:

I am pleased to provide you with the 1965 Annual Report for the Markham Village Water Pollution Control Plant, OWRC Projects Nos. 59-S-40 and 60-S-55.

We appreciate the co-operation you have extended to our Operations staff throughout the year, and trust that continuation of this close association will ensure even greater progress in the sphere of water pollution control.

Yours very truly,

D. S. Caverly,
General Manager.

ONTARIO WATER RESOURCES COMMISSION

801 BAY STREET

TORONTO 5

J. A. VANCE, LL.D.
CHAIRMAN

J. H. H. ROOT, M.P.P.
VICE-CHAIRMAN

D. S. CAVERLY
GENERAL MANAGER

W. S. MacDONNELL
COMMISSION SECRETARY

General Manager,
Ontario Water Resources Commission.

Dear Sir:

I am pleased to provide you with the 1965 Annual Report on the operation of the Markham Village Water Pollution Control Plant, OWRC Project Nos. 59-S-40 and 60-S-55.

The report presents design data, outlines operating problems encountered during the year and summarizes in graphs, charts and tables all significant flow and cost data.

Yours very truly,

B. C. Palmer, P. Eng.,
Director,
Division of Plant Operations.

FOREWORD

This report provides useful information on the operating efficiency of this project during 1965. It is intended to act as a guide in gauging plant performance. To implement that aim, it includes detailed statistical and cost data, a description of the project and a summary of its operation during the year.

Of particular interest will be the cost data, which show the total cost to the municipality and the areas of major expenditure.

The Regional Operations Engineer is primarily responsible for the preparation of the report, and has compiled and arranged the material. He will be pleased to answer any questions regarding it. Other groups, however, were involved in the production, and these include the statistics section, the Drafting Section of the Division of Sanitary Engineering and the Division of Finance.

B. C. Palmer, P. Eng.,
Director,
Division of Plant Operations.

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MARKHAM VILLAGE
water pollution control plant

operated for

THE VILLAGE OF MARKHAM

by the

ONTARIO WATER RESOURCES COMMISSION

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VICE-CHAIRMAN: J. H. H. Root, M.P.P.

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L. E. Venchiarutti

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F. A. Voege
K. H. Sharpe
A. K. Watt

COMMISSION SECRETARY

W. S. MacDonnell

DIVISION OF PLANT OPERATIONS

DIRECTOR: B. C. Palmer

Assistant Director: C. W. Perry
Regional Supervisor: D. A. McTavish
Operations Engineer: R. Kauppinen

801 Bay Street Toronto 5

'65 REVIEW

The Markham Village Water Pollution Control Plant treated a total of 116.884 million gallons of raw sewage in 1965 at a cost of $15,909.13. This represents $136.11 per million gallons compared to $179.62 in 1964. The decrease in cost can be attributed mainly to the increased flows.

The flow to the plant was above the design flow approximately 38% of the time and as a result the quality of the final effluent was poorer than normally expected for secondary treatment plants.

In April, work was performed to increase the aeration capacity. The blower capacity was increased from 400 CFM to 700 CFM and modifications were made to the diffusers.

GLOSSARY

BOD	biochemical oxygen demand (a measure of organic content)
cfm	cubic feet per minute
comminution	shredding of solids into small fragments
DWF	dry weather flow
effluent	outflow
flocculation	bringing very small particles together to form a larger mass (the floc) before settling
fps	feet per second
gpcd	gallons per capita per day
gpm	gallons per minute
grit	sand, dust, stones, cinders and other heavy inorganic material
influent	inflow
lin. ft.	lineal feet
mgd	million gallons per day
mlss	mixed liquor suspended solids
ppm	parts per million
ss	suspended solids
TDH	total dynamic head (usually refers to pressure on a pump when it is in operation)

HISTORY
1958 - 1965

INCEPTION

In 1958, the Village of Markham and the Ontario Water Resources Commission initiated plans for the construction of a modern sewage treatment plant.

The firm of R. V. Anderson and Associates Limited, Toronto, Ontario was engaged to prepare plans and specifications for the project.

APPROVAL

In July 1959, the village signed an agreement with the Ontario Water Resources Commission to finance, construct and operate the plant, OWRC Project 59-S-40. There was another agreement signed in February 1960 for the construction and operation of a sewage pumping station on the plant property and the West Rouge trunk sewer, OWRC Project 60-S-55.

CONSTRUCTION

Pearce Construction Limited, Hagersville, Ontario, began construction of the plant in September 1959 and in December 1960 the Division of Plant Operations took over the operation.

Swansea Construction Company Limited, Toronto, Ontario commenced construction of the pumping station and sewer in December 1960 and in July 1961 this also came under the control of the Division of Plant Operations.

TOTAL COSTS

The combined total cost of the two projects, 59-S-40 and 60-S-55, was $840,329.00.

I. BARON
CHIEF OPERATOR

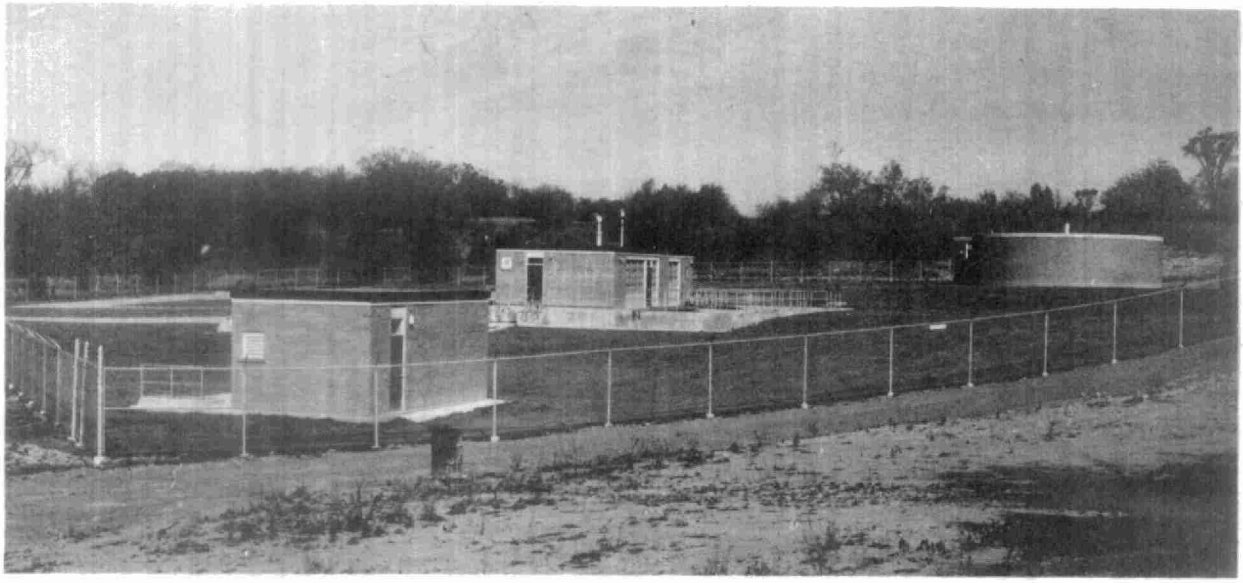
Project Staff

Operator - J. Moment

COMMENTS

The Markham Village Water Pollution Control Plant is presently under eight hours supervision during the week and partial supervision on the week ends. The plant has a complement of two men. The Chief Operator is Mr. I. Baron. Mr. E. C. Brophy was the operator until he ceased employment in September 1965. A new operator, Mr. J. Moment, was employed in October. The plant staff has operated the plant efficiently and economically in the past year.

Mr. Baron has successfully completed the Senior Sewage Operators' course offered by the Ontario Water Resources Commission and has been awarded a Certificate of Qualification as a Sewage Works Operator. Mr. Moment is scheduled to begin courses which will eventually lead to a Certificate.



Description of Project

PUMPING MANHOLES

There are two temporary pumping manholes on the sanitary sewer system. These manholes will not be required once the system's expansion program is completed as the sewage then flows by gravity to the plant site.

RAW SEWAGE LIFT STATION

The West Rouge trunk sewer which serves the westerly portion of Markham Village empties into the wet well portion of the raw sewage lift station approximately 35 feet below normal plant elevation. The sewage is then pumped to the influent works by either one of two vertical dry well centrifugal pumps after first passing through a bar screen.

INFLUENT WORKS

The influent works at the plant provide for screening, shredding and grit removal. The screening and shredding is accomplished as the sewage passes through a 18" model C Barminutor. Grit is removed from the sewage by means of an air degrittor. Both these units are provided with bypass channels, the barminutor bypass being equipped with a coarse bar screen.

The sewage after passing through the air degrittor flows to the primary sedimentation tank which is designed to provide an adequate detention period to allow the heavier solids to settle out, and for the removal of surface scum and grease.

The primary sedimentation tank is equipped with longitudinal sludge collectors which serve as skimming mechanisms for removal of surface material and for transferring settled sludge to a point from which it may be pumped directly to the digester.

The primary tank is designed to provide a detention period, sufficient to remove approximately 30-35% of the heavy organic material.

The settled waste water flows over the effluent weirs and discharges into the aeration tank.

AERATION

The flow upon entering the aeration tank undergoes another detention period which provides the biological environment required to remove the finely divided, suspended and dissolved organic materials remaining in the flow

The settled sludge (activated sludge), from the final sedimentation tank, is recirculated back to the aeration tanks, and mixes with the incoming effluent from the primary tanks. This mixed liquid is then aerated by air which is supplied from a compressor. The air supplied provides the oxygen requirements of the biological communities of aerobic microorganisms (mixed liquor sludge floc) and also produces a roll which prevents settling in the tanks. The activated sludge which is returned acts as the vehicle for the bacteria which in turn oxidizes the organic material contained in the water.

The mixed liquor then passes into the final settling tanks.

FINAL SEDIMENTATION

The final sedimentation tank provides a detention period to allow remaining activated sludge solids to settle out. The activated sludge is returned to the aeration tank to provide the continuous environment for the maintenance of the floc in the aeration section.

The final sedimentation tank is equipped with chain drive sludge collectors which collect the sludge to a central point from which it is returned to either the primary sedimentation tank or the aeration tank.

DIGESTION

The sludge and scum collected in the primary sedimentation tank is pumped to the digester, In the absence of air, and in a regulated temperature of 90 degrees Fahrenheit, the decomposing or digestion process begins. Constant agitation within the tank ensures overall treatment.

The raw sludge is broken down by anaerobic bacterial action and, when thoroughly digested, is a thick, black odourless liquid.

Sludge gas (principally methane), formed during the process, is used as a fuel to heat the digester. In the absence of sufficient methane gas, oil is used to heat the digester.

CHLORINATION

The chlorinator injects chlorine into the final effluent to reduce the bacterial count to acceptable limits.

CONTROL BUILDING

The control building houses an office and laboratory, as well as the following equipment.

Main control panel, chlorinator, air blower, raw sludge pump, return activated sludge pump, standby pump, a water seal unit and a heat exchanger. A small work shop is also provided. Equipment required in future expansion of the plant may also be housed in the control building.

PROJECT COSTS

(59-S-40 ONLY)

NET CAPITAL COST (Final) Long Term Debt to OWRC	$608,711.07
Debt Retirement Balance at Credit (Sinking Fund) December 31, 1965	$ 70,071.58
Net Operating	15,909.13
Debt Retirement	12,284.00
Reserve	3,411.35
Interest Charged	34,152.95
TOTAL	$ 65,757.43

RESERVE ACCOUNT

Balance at January 1, 1965	$ 17,361.39
Deposited by Municipality	3,411.35
Interest Earned	1,033.63
	$ 21,806.37
Less Expenditures	-
Balance at December 31, 1965	$ 21,806.37

MONTHLY OPERATING COSTS

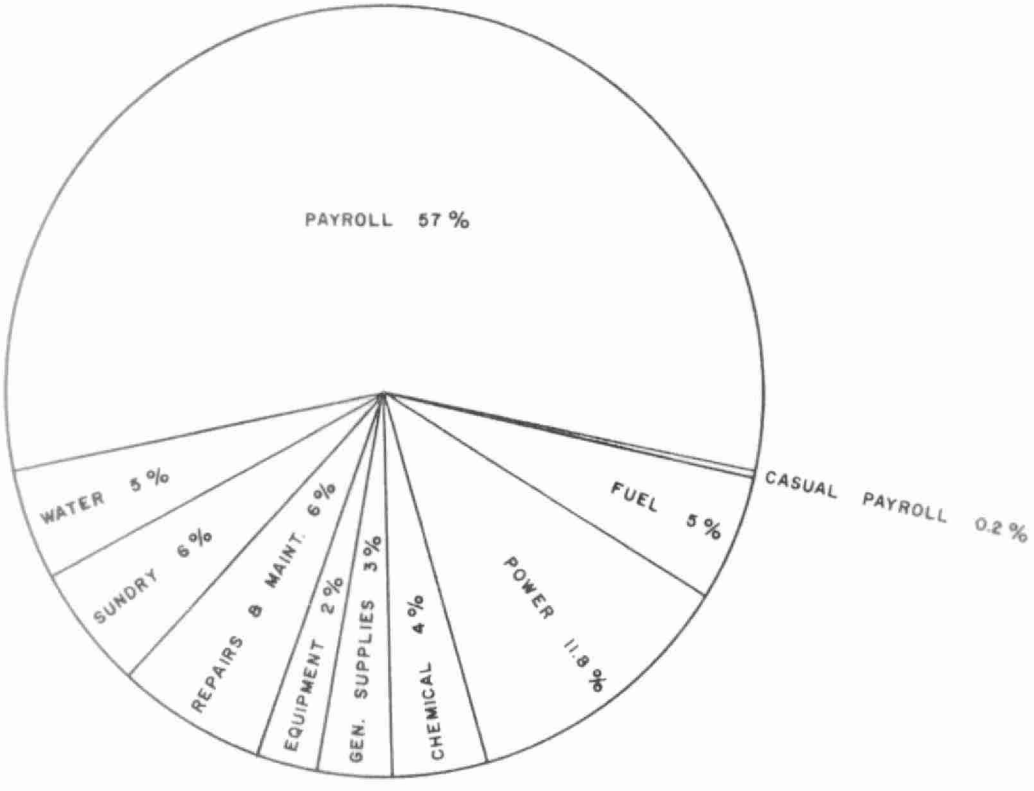
MONTH	TOTAL EXPENDITURE	PAYROLL	CASUAL PAYROLL	FUEL	POWER	CHEMICAL	GENERAL SUPPLIES	EQUIPMENT	REPAIRS & MAINTENANCE	SUNDRY	WATER
JAN	868.41	684.82		115.06			55.09			13.44	
FEB	935.49	312.20		104.95	151.46	224.03	2.00		8.06	57.73	75.06
MARCH	1526.46	684.82		201.91	156.25		67.58		383.66	32.24	
APRIL	1393.35	900.59		211.97	134.57					25.24	120.98
MAY	1409.96	1068.84			167.97		31.73		109.30	32.12	
JUNE	1313.78	712.56		112.80	178.32		84.40		89.70	18.79	117.21
JULY	1377.97	712.56			168.06	224.03	32.81	220.32		20.19	
AUG	1274.93	712.56			179.32		55.39	36.00	54.88	69.93	166.85
SEPT	918.16	623.19	31.35		185.99		48.14			24.49	
OCT	1507.32	1040.51			185.03		21.74	125.99		33.03	101.02
NOV	2133.01	820.72		114.21	180.16	224.03	11.40		288.79	493.70	
DEC	1250.29	739.35			188.69		95.84		66.99	30.23	129.19
TOTAL	15909.13	9012.72	31.35	860.90	1875.82	672.09	506.12	382.31	1001.38	856.13	710.31

YEARLY OPERATING COSTS

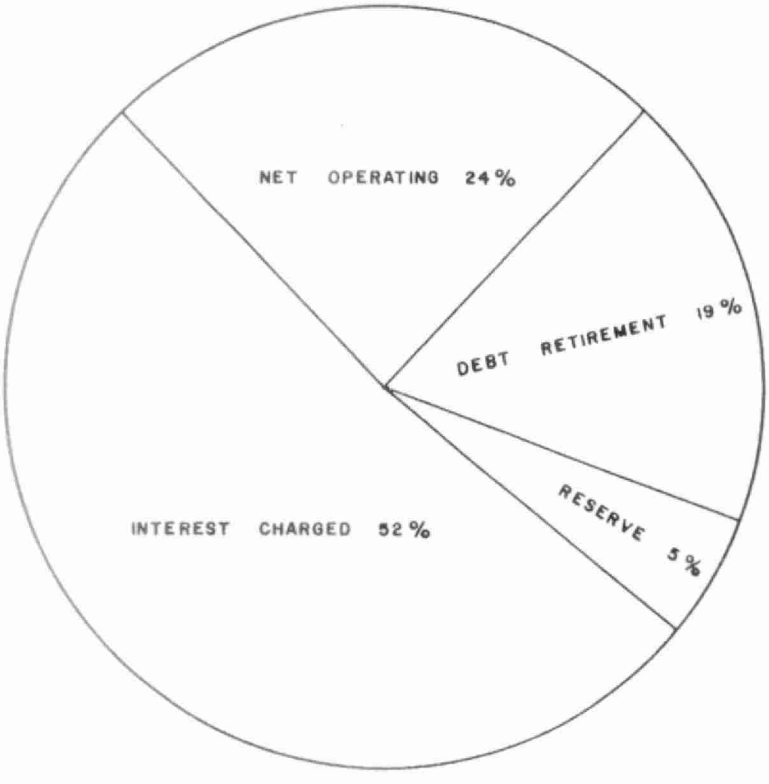
YEAR	M.G. TREATED	TOTAL COST	COST PER FAMILY PER YEAR *	COST PER MILLION GALLONS	COST PER L.B. OF BOD REMOVED
1961	27.375	$ 14395.33	$ 13.03	$ 525.85	23 CENTS
1962	45.625	15920.73	13.57	348.94	14 CENTS
1963	60.225	16771.42	12.40	278.00	11 CENTS
1964	84.180	15120.53	10.34	179.62	7 CENTS
1965	116.884	15909.13	9.27	136.11	8 CENTS

* BASED ON ESTIMATED ANNUAL POPULATION AND 3.9 PERSONS PER FAMILY

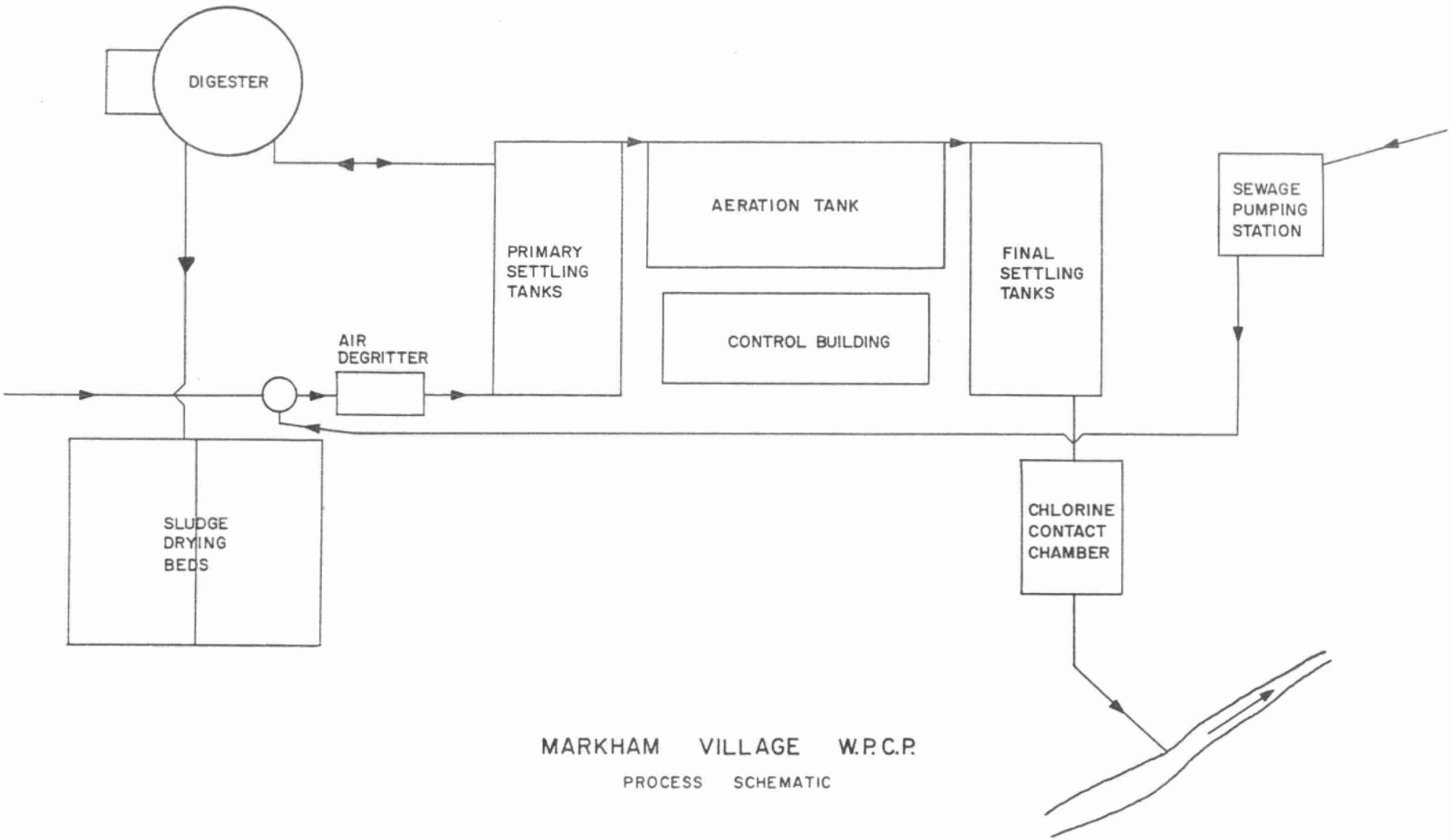
1965 OPERATING COSTS



TOTAL ANNUAL COST



Technical Section



MARKHAM VILLAGE W.P.C.P.

PROCESS SCHEMATIC

Design-Data

GENERAL

Type of Plant - Activated Sludge

Design Population - 4,000 persons

Design Plant Flow - 334,000 gallons per day

Per Capita Flow - 83.5 gallons per day

Five Day BOD

Raw Sewage - 215 ppm

Removal - 95%

Suspended Solids

Raw Sewage - 250 ppm

Removal - 95%

PUMPING STATION

Screen

One and one-quarter inch x 5/16 inch galvanized steel bars at 1 1/2 inch centres.

Raw Sewage Well

Size - 21.42 ft. x 9.75 ft. x 6 ft. (maximum depth).
Sloped bottom to pump suctions.

Volume - approximately 975 cubic feet, or 6,080 gallons.

Raw Sewage Lift Pumps

Two Fairbanks-Morse vertical centrifugal pumps, each rated at 350 GPM at a head of 40 ft. and each driven by a 20 HP Westinghouse electric motor.

Screen and Shredder

Barminutor - Chicago Pump Company - Model - C9.

Screen - on bypass channel around barminutor - 1 1/4 inch x 3/16 inch bars at 1 inch centres.

Aerated Grit Tank

Size - 13 ft. x 6 ft. x 8.13 ft. SWD - hopper bottom.

Volume - 680 cubic feet, or 4,240 gallons (including hopper).

Retention - 18.35 minutes at 333,000 GPD - 7.36 minutes at 833,000 GPD (2.5 DWF).

Grit Decanting Trough

Four pass with each channel being 5.5 ft. x 1 ft. x 1.75 ft. (to top of wall).

Bypass - aerated grit tank can be completely bypassed.

Primary Settling Tank

Size - 42 ft. x 12 ft. x 7.75 ft. (average liquid depth).

Volume - 3,905 cubic feet, or 24,400 gallons

Retention - 1.76 hours at 333,000 GPD 0.71 hours at 833,000 GPD (2.5 DWF).

Surface Settling Rate - 661 gallons per square ft. per day at 333,000 GPD. 1650 gallons per square foot per day at 833,000 GPD (2.5 DWF).

Weir Overflow Rate - 27,800 gallons per lineal ft. of weir per day at 333,000 GPD.

69,400 gallons per lineal ft. of weir per day at 833,000 GPD (2.5 DWF).

Raw Sludge Pump

1 - Wemco-Torque flow pump rated at a maximum of 150 U.S. GPM at a head of

28.5 ft. and driven by a 5 HP U.S. Varidrive electric motor.

Aeration Tank

Size - 51 ft. x 22 ft. x 15 ft. (SWD).

Volume - 16,810 cubic feet, or 105,000 gallons.

Retention - 7.57 hours @ 333,000 GPD (no return sludge)
6.06 hours @ 416,250 GPD (25% return sludge).
100 Sparjers

Blowers

1 - Sutorbilt Corp. (Size - 12 x 11, Disp. 1.5) blower rated at approximately 700 cfm at 5 psi and driven by a 30 HP Leland Newman electric motor.

1 - Burgess-Manning snubber.

Secondary Settling Tank

Size - 42 ft. x 12 ft. x 10.5 ft. (average liquid depth).

Volume - 5,290 cubic feet, or 33,000 gallons.

Retention - 2.38 hours @ 333,000 GPD (no return sludge).

1.91 hours @ 416,250 GPD (25% return sludge.

Surface Settling Rate - 661 gallons per square ft. per day @ 333,000 gpd.
Weir Overflow Rate - 4,750 gallons per lineal ft. of weir per day @ 333,000 gpd.

Return Sludge Pump

1 - Fairbanks-Morse vertical centrifugal pump rated at a maximum of 150 GPM at a head of 18 ft. and driven by a 2 HP U.S. Varidrive electric motor.

Chlorine Contact Chamber

(3 round-the-end baffles)

Size - 20 ft. x 11.38 ft. x 8.5 ft. (SWD).
Volume - 1,935 cubic feet, or 12,080 gallons.

Retention - 52.2 minutes @ 333,000 gpd.

Chlorinator

1 - Wallace and Tiernan V-notch Variable Orifice gas chlorinator with a range of 0 to 40 pounds of chlorine per 24 hours.

Digester

Size - 45 ft. in diameter x 20 ft. (SWD).

Volume - 34,240 cubic feet, or 220,000 gallons.

Digester Contents Recirculating Pump

1 - Fairbanks-Morse horizontal centrifugal pump rated at 150 gpm and driven by a 3 HP Westinghouse electric motor.

Heat Exchanger

1 - Pacific Flush Tank Company heat exchanger which can burn either oil or sludge gas.

Sludge Drying Beds

Size - 4 each 90 ft. x 20 ft.

Area - 7,200 square feet.

Capacity - 1.8 square feet per capita @ 4,000 persons.

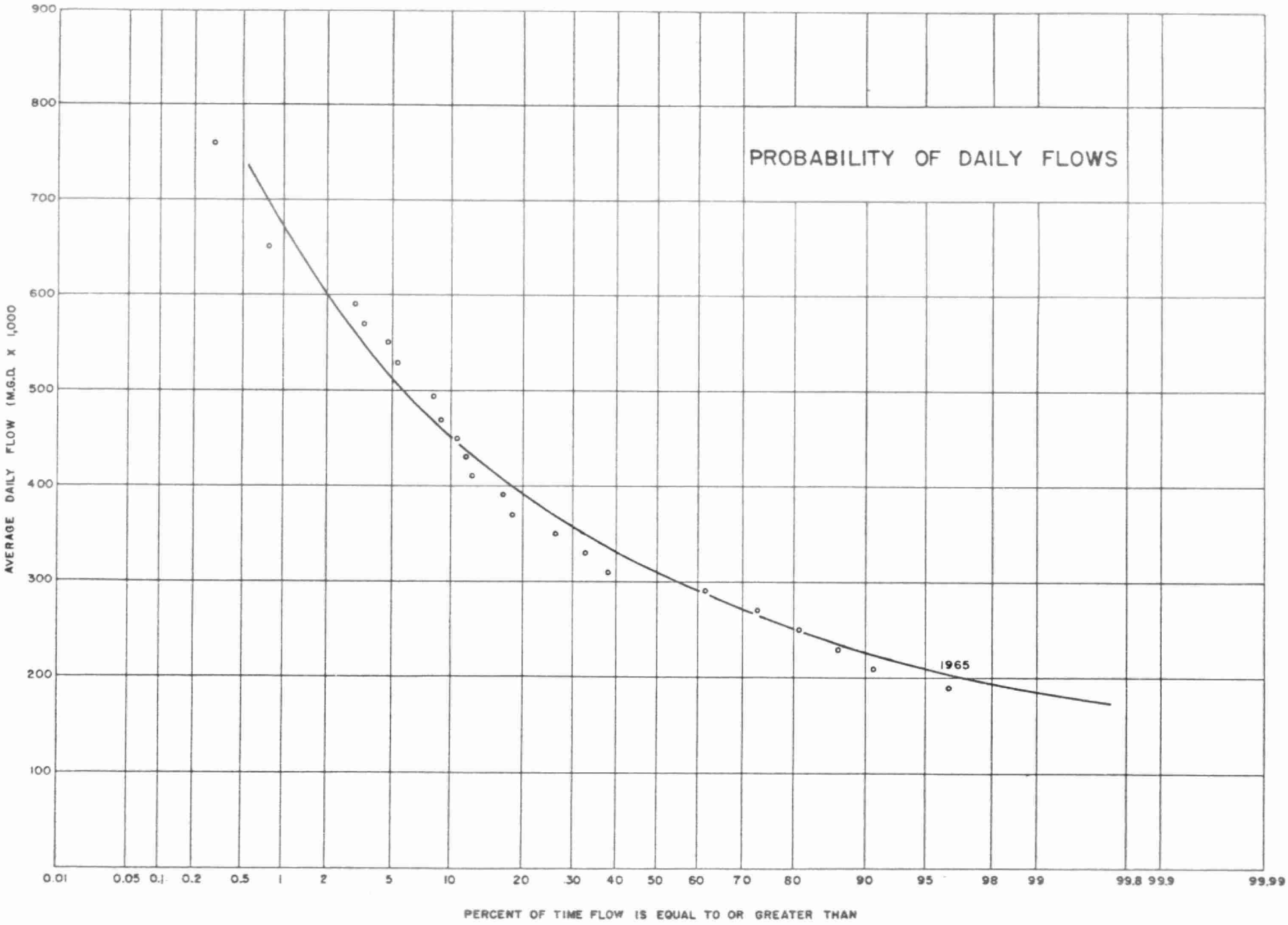
Flow Meter

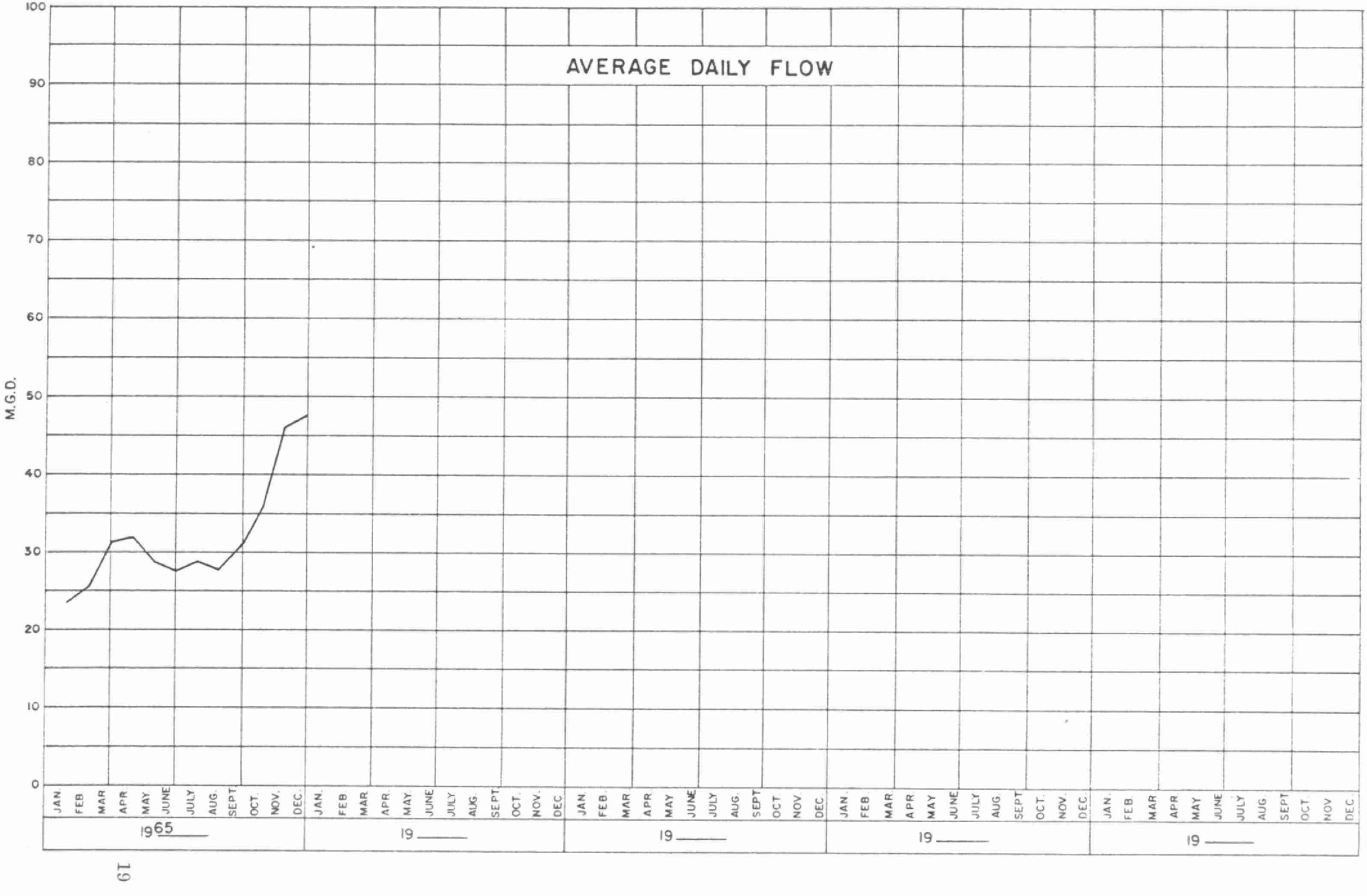
1 - Foxboro (model 40) totalizer, recorder and indicator to operate from a 9-inch Parshall flume.

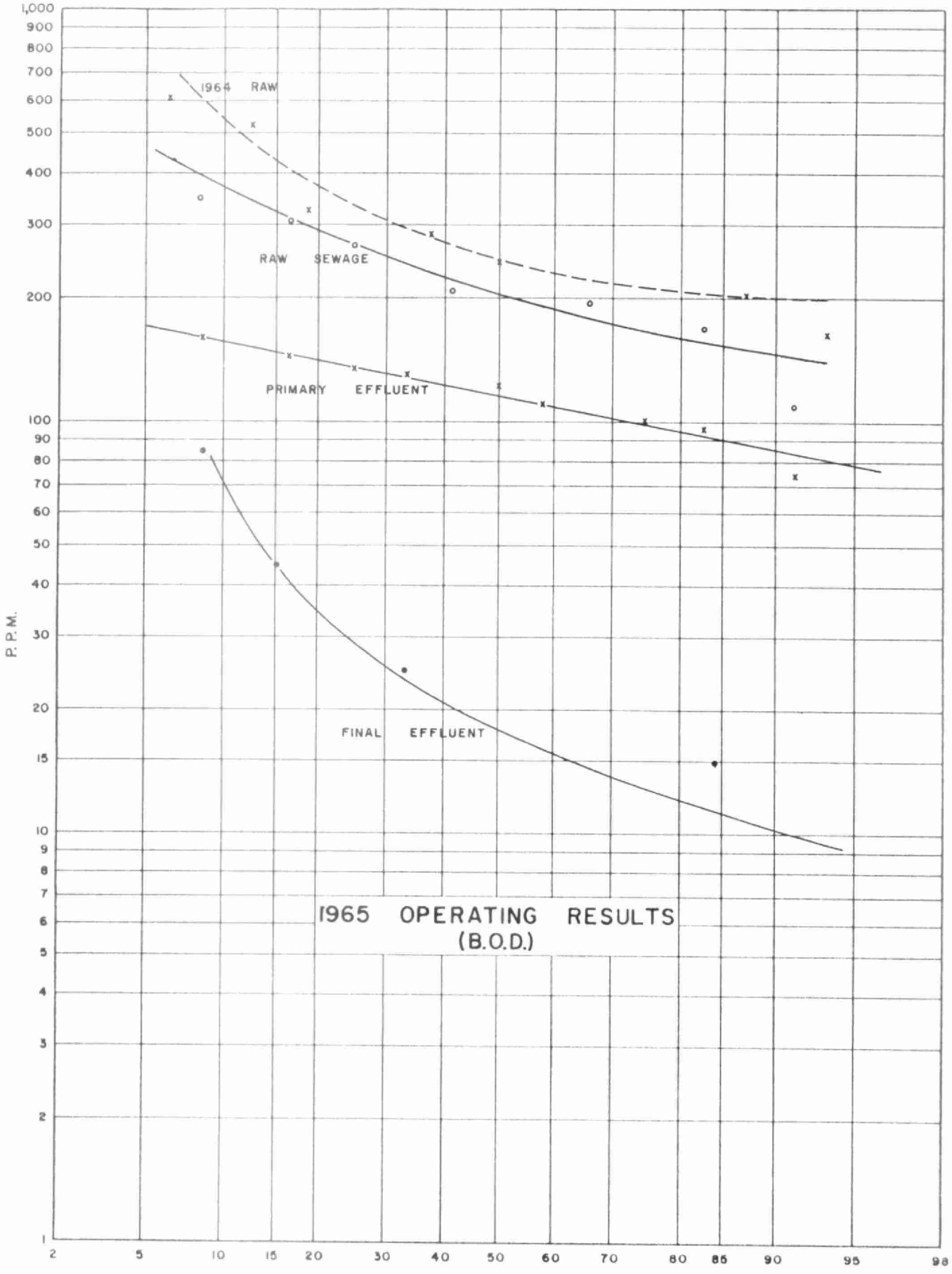
Process Data

The following charts and graphs indicate that a total of 116,884,000 gallons of raw sewage was treated in 1965, which is an average daily flow of 320,000 gallons per day. As shown in the monthly flows in the table entitled Chlorination, the monthly flows increased during the latter part of the year.

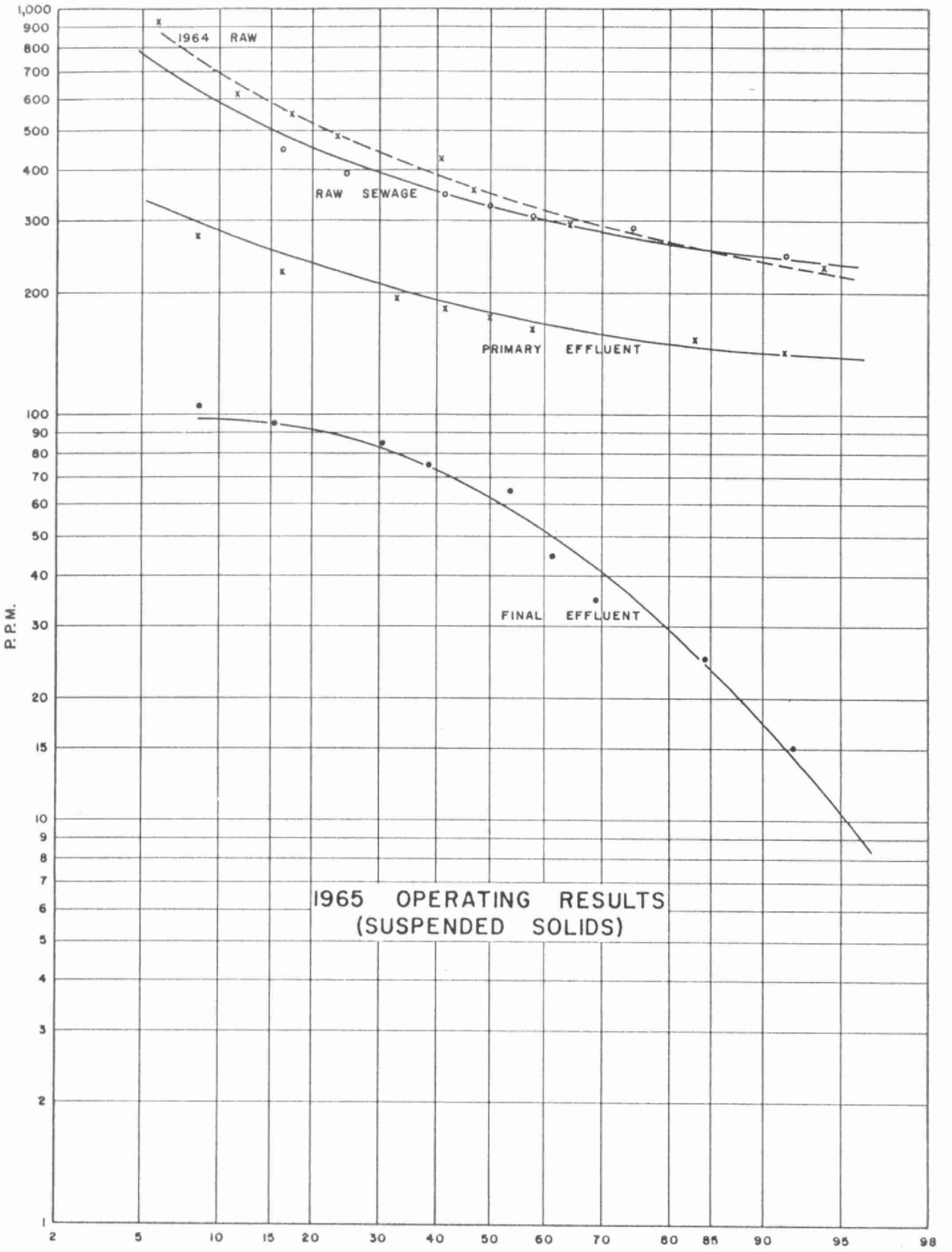
All flows up to the design flow of 334,000 gallons per day were given secondary treatment and any flow in excess of the design flow was given primary treatment only. The flow exceeded the design flow approximately 38% of the time.


PROBABILITY OF DAILY FLOWS
AVERAGE DAILY FLOW (M.G.D. X 1,000
900
800
700
600
500
400
300
200
100
1965
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.8
99.9
99.99
PERCENT OF TIME FLOW IS EQUAL TO OR GREATER THAN

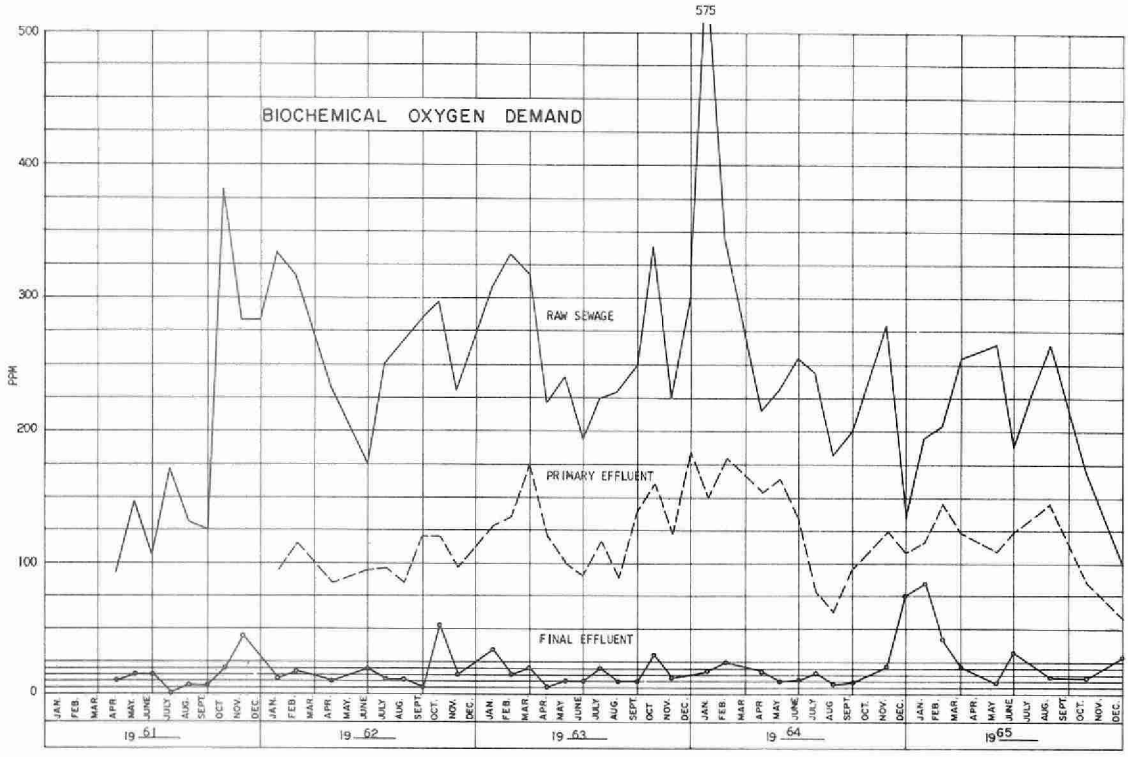

AVERAGE DAILY FLOW
M.G.D.
100
90
80
70
60
50
40
30
20
10
0
JAN. FEB MAR APR MAY JUNE JULY AUG. SEPT OCT. NOV. DEC.
1965
19 ____



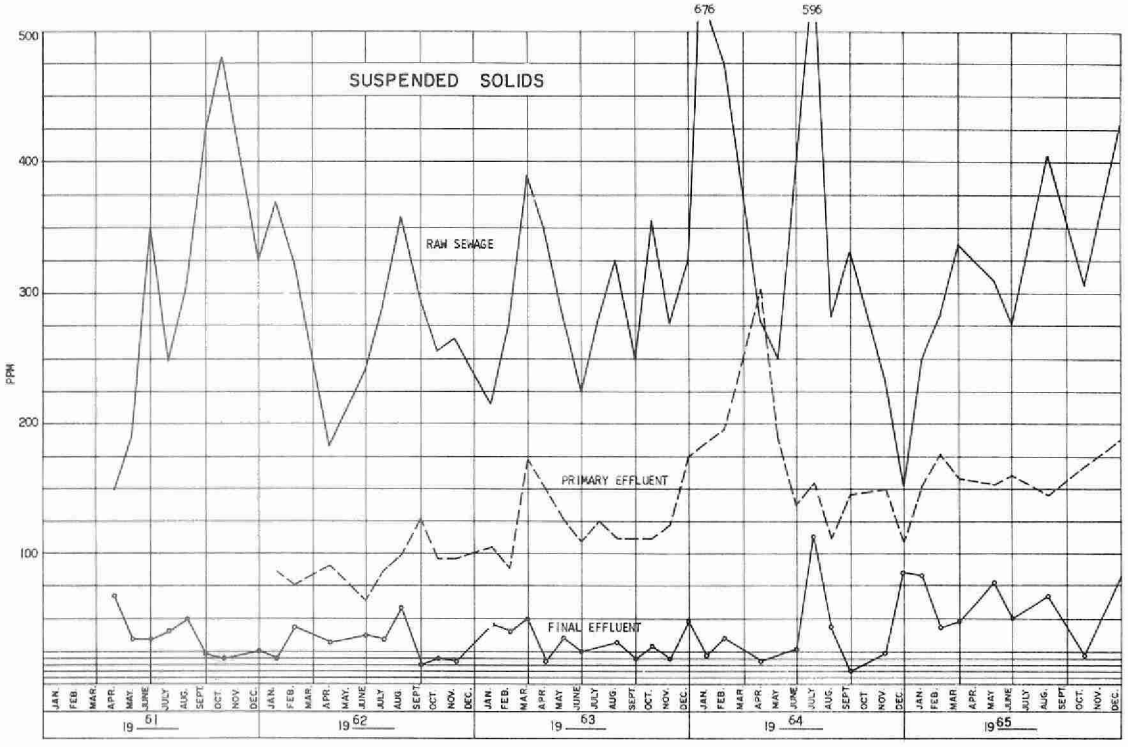
1965 OPERATING RESULTS
(B.O.D.)



1965 OPERATING RESULTS
(SUSPENDED SOLIDS)



MONTHLY VARIATIONS



GRIT, B.O.D AND S.S. REMOVAL

MONTH	B. O. D.				S. S.				GRIT REMOVAL CU. FT.
	INFLUENT P.P.M.	EFFLUENT P.P.M.	% REDUCTION	TONS REMOVED	INFLUENT P.P.M.	EFFLUENT P.P.M.	% REDUCTION	TONS REMOVED	
JAN.	195	86	56.0	3.9	250	62	75.0	6.8	-
FEB.	205	42	79.5	5.7	284	84	70.5	7.0	16
MAR.	255	20	92.0	11.4	339	46	86.5	14.2	-
APR.	*205	31	85.0	8.3	*328	65	80.0	12.5	13
MAY	265	8.4	97.0	11.4	310	76	75.5	10.4	6
JUNE	188	34	82.0	6.3	275	50	82.0	9.2	6
JULY	*205	31	85.0	7.7	*328	65	80.0	11.7	28
AUG.	265	14	94.5	10.9	405	68	83.0	14.6	20
SEPT.	*205	31	85.0	8.0	*328	65	80.0	12.2	26
OCT.	168	12	93.0	8.6	306	22	93.0	15.6	18
NOV.	* 205	31	85.0	12.0	*328	65	80.0	18.2	28
DEC.	100	29	71.0	5.2	458	110	76.0	25.5	12
TOTAL	-	-	-	101.7	-	-	-	153.9	173
AVG.	205	31	85.0	8.5	328	65	80.0	12.8	14

COMMENTS

The raw sewage had an average strength of 205 ppm BOD and 328 ppm SS. The final effluent had an average of 21 ppm BOD and 65 ppm SS for an average reduction of 85.0% in BOD and 80.0% in SS for the plant.

The quality of the final effluent was poorer than is normally expected from a plant giving secondary treatment. This was due to the fact that when the flow was above the design capacity, the final effluent was a mixture of primary treated and secondary treated sewage.

A total of 173 cubic feet of grit was removed for an average of 1.48 cubic feet per million gallons treated.

DIGESTER OPERATION

MONTH	SLUDGE TO DIGESTERS			SLUDGE FROM DIGESTERS			GAS PRODUCED 1000'S Cu. Ft.
	1000'S CU FT	% SOLIDS	% VOL. MAT	1000'S CU FT.	% SOLIDS	% VOL. MAT	
JAN.	7.95	-	-	-	-	-	-
FEB.	6.67	-	-	-	-	-	-
MAR.	7.95	-	-	-	-	-	-
APR.	7.69	-	-	1.40	-	-	-
MAY	7.95	-	-	1.35	-	-	-
JUNE	7.69	4.10	2.93	1.35	6.25	3.00	-
JULY	7.95	-	-	-	-	-	-
AUG.	7.95	4.48	2.52	2.73	5.90	-	-
SEPT.	7.69	-	-	2.86	-	-	-
OCT.	7.95	-	-	2.75	5.88	-	-
NOV.	5.35	-	-	-	-	-	-
DEC.	3.21	-	-	-	-	-	-
TOTAL	86.00	-	-	12.44	-	-	-
AVG.	7.19	4.29	2.72	2.07	6.01	3.00	-

COMMENTS

A total of 86,000 cubic feet of sludge was pumped to the digester and 12,440 cubic feet of digested sludge was removed from the digester to the sludge drying beds.

An inspection was made of the digester in November and as a result a complete digester cleanout was proposed for 1966.

CHLORINATION

MONTH	PLANT FLOW (MG)	POUNDS CHLORINE	DOSAGE RATE (PPM)
JANUARY	7.200	* 296	4.72
FEBRUARY	7.035	349	4.96
MARCH	9.665	325	3.36
APRIL	9.540	346	3.63
MAY	8.910	363	4.07
JUNE	8.230	377	4.58
JULY	8.885	375	4.22
AUGUST	8.651	378	4.37
SEPTEMBER	9.258	372	4.02
OCTOBER	11.020	397	3.60
NOVEMBER	13.810	400	2.90
DECEMBER	14.680	457	3.11
TOTAL	116.884	4435	-
AVERAGE	9.740	370	3.82

Flow data are operator's estimates.
* 27 days chlorination.

COMMENTS

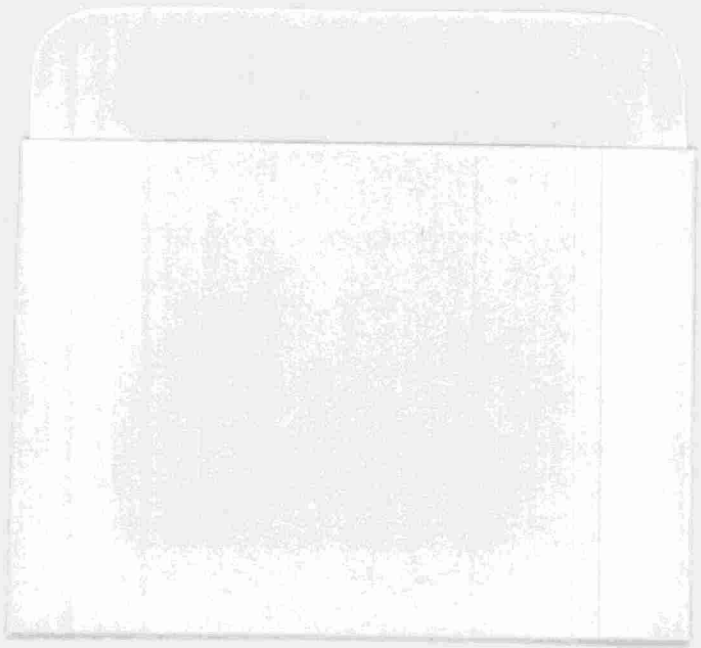
Chlorination was carried out throughout the year with an average chlorine dosage of 3.82 ppm which is normal for an activated sludge water pollution control plant.

CONCLUSIONS

The increased flow and the quality of the effluent indicate that the plant is overloaded.

RECOMMENDATIONS

The plant capacity should be increased to treat the increased loadings.




ONTARIO WATER RESOURCES COMMISSION